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IS 11333 (1985): Flameproof Dry Type Transformers For Use
in Mines [ETD 16: Transformers]



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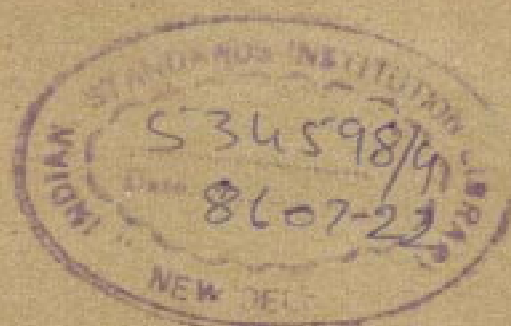
“Knowledge is such a treasure which cannot be stolen”

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Indian Standard
SPECIFICATION FOR
FLAMEPROOF DRY TYPE TRANSFORMERS
FOR USE IN MINES

UDC 621.314.21-213.34 : 622.812.2



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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR FLAMEPROOF DRY TYPE TRANSFORMERS FOR USE IN MINES

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Indian Standard

SPECIFICATION FOR FLAMEPROOF DRY TYPE TRANSFORMERS FOR USE IN MINES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 13 June 1985, after the draft finalized by the Transformers Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard is one of the series of Indian Standards relating to several items of electrical equipment used in mines and other hazardous locations, that have been drawn up.

0.3 The requirements for flameproof enclosures of electrical machinery and apparatus for use in mines and such other places where flammable gases or vapours may exist, are covered in IS : 2148-1981*. The performance and other allied requirements of transformers are covered in IS : 11171-1985† and various parts of IS : 2026‡. These standards, therefore, form necessary adjuncts to this standard.

0.4 The transformers complying with this standard are suitable for Group I enclosures (Methane/fire damp), but they may also be suitable for other groups of gases, provided checks and tests for flameproofness corresponding to these groups of gases are carried out in accordance with IS : 2148-1981*.

0.5 In preparing this standard, assistance has been derived from BS 5067 : 1974 'Flameproof transformers for use in mines' issued by the British Standards Institution.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960§. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Specification for flameproof enclosures of electrical apparatus (*second revision*).

†Specification for dry type power transformers.

‡Specification for power transformers : Part 1 General (*first revision*). Part 2 Temperature rise (*first revision*). Part 3 Insulation levels and dielectric tests (*second revision*).

Part 4 Terminal markings, tapplings and connections (*first revision*).

§Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers requirements for dry type flameproof three-phase transformers intended for use below ground in mines and other hazardous areas.

NOTE — The transformers covered in this standard can also be used as trans-switch units with switchgears.

1.2 This standard does not apply to intrinsically safe transformers which are covered in IS : 10406-1983*.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 1885 (Part 38)-1977† shall apply.

3. RATINGS

3.1 kVA Ratings—The kVA ratings shall be 160, 200, 250, 315, 400 and 500.

3.2 Rated Voltage—Rated no-load voltage shall be as under:

Primary voltage : 3 300 and 6 600 V

Secondary voltage : 433, 565 and 1 130 V

3.3 Rated Frequency—The rated frequency shall be 50 Hz.

4. METHOD OF COOLING

4.1 The method of cooling shall be ANAN in accordance with IS : 2026 (Part 2)-1977‡.

5. TEMPERATURE-RISE

5.1 The provisions of 5.2 of this standard shall be applicable, in addition to those of 3 of IS : 2026 (Part 2)-1977‡.

5.2 The temperature-rise of any part of the external surface of the enclosure shall not exceed 60°C.

*Specification for intrinsically safe transformer primarily for bell signalling circuits.

†Electrotechnical vocabulary: Part 38 Transformers (*first revision*).

‡Specification for power transformers: Part 2 Temperature rise (*first revision*).

6. WINDING CONNECTIONS AND TAPPINGS

6.1 The winding connections for three-phase transformers shall be delta on the primary side and star on the secondary side. The vector group shall be Dyn 11 [see IS : 2026 (Part 4)-1977*].

6.2 Adjusting tappings shall be provided on the primary voltage windings for a primary voltage adjustment of -5 and -10 percent of the rated voltage.

6.2.1 A readily accessible off-circuit tap selecting device shall be provided for tap changing.

7. PERFORMANCE

7.1 Unless otherwise mentioned in this standard, the transformers shall comply with the requirements of IS : 11171-1985† and relevant parts of IS : 2026‡ as applicable for dry-type transformers.

7.1.1 Tolerances — The tolerances as given in Table 7 of IS : 2026 (Part 1)-1977‡ shall be permissible on the values to be declared by the manufacturer.

7.2 Impedance — Recommended percentage impedance at 75°C is 4 percent.

8. GENERAL DESIGN AND CONSTRUCTION

8.1 Flameproof Construction — The transformers shall be constructed in accordance with the requirements of IS : 2148-1981§.

8.2 Materials — The transformer enclosure shall be made of mild steel plate and shall be of substantial construction in order to withstand the rough conditions of handling to which the transformer may be subjected, particularly when being pushed into and out of cages and when being transported below ground.

8.2.1 No aluminium or alloys of aluminium, or magnesium, or paint containing aluminium shall be employed on exterior part of the transformer tank or fittings.

8.3 The tank lid, and inspection covers, if any, shall be so arranged that they can be removed and replaced without disturbing the cable connections.

*Specification for power transformers: Part 4 Terminal markings, tappings and connections (*first revision*)

†Specification for dry type power transformers.

‡Specification for power transformers: Part 1 General (*first revision*). Part 2 Temperature (*first revision*). Part 3 Insulation levels and dielectric tests (*second revision*). Part 4 Terminal markings, tappings and connections (*first revision*).

§Specification for flameproof enclosures of electrical apparatus (*second revision*).

8.4 Removable Cover — Each removable door or cover which gives access to an enclosure containing live components including any neutral link shall carry the warning : 'ISOLATE TRANSFORMER FROM SUPPLY AT HT END BEFORE REMOVING THIS COVER'. This warning shall be embossed on the door or cover, or shall be of indelible lettering on a metal plate of substantial thickness permanently secured to the door or cover.

8.5 Lifting Lugs — Four lifting lugs (two on each side), each fitted with a shackle shall be provided on the enclosure body of the transformer. Each lug and shackle shall be of sufficient strength to support the whole weight of the transformer, complete with ancillary equipment, when slung by any one lug. Additional lugs shall be provided at one end of the enclosure for lowering the transformer on end down a mine, using two of the aforementioned shackles. Means shall also be provided for the attachment of haulage chains to the fender or base of the tank.

8.6 Lifting and Anchoring of Core — The core and winding assembly shall be provided with means for attaching lifting shackles.

8.6.1 Means shall also be provided to ensure correct registration of the core in the tank, and to prevent movement of the core and windings when the tank is on its side or end.

8.7 Wheels — Provision shall be made for the mounting of axles fitted with flanged wheels having a tread diameter of 305 mm. Further provision shall be made in the roller mounting for setting the clearance between rail level and the bottom of the transformer tank at either 25 mm or 125 mm. The wheels and axles may be supplied with the transformer, if agreed between the purchaser and the supplier.

8.7.1 The wheels and axles shall be arranged to fit rail gauges within either of the ranges 457 mm to 769 mm or 610 mm to 922 mm, increasing in each range by increments of 13 mm. When other rail gauges have to be met, the purchaser shall specify the requirements.

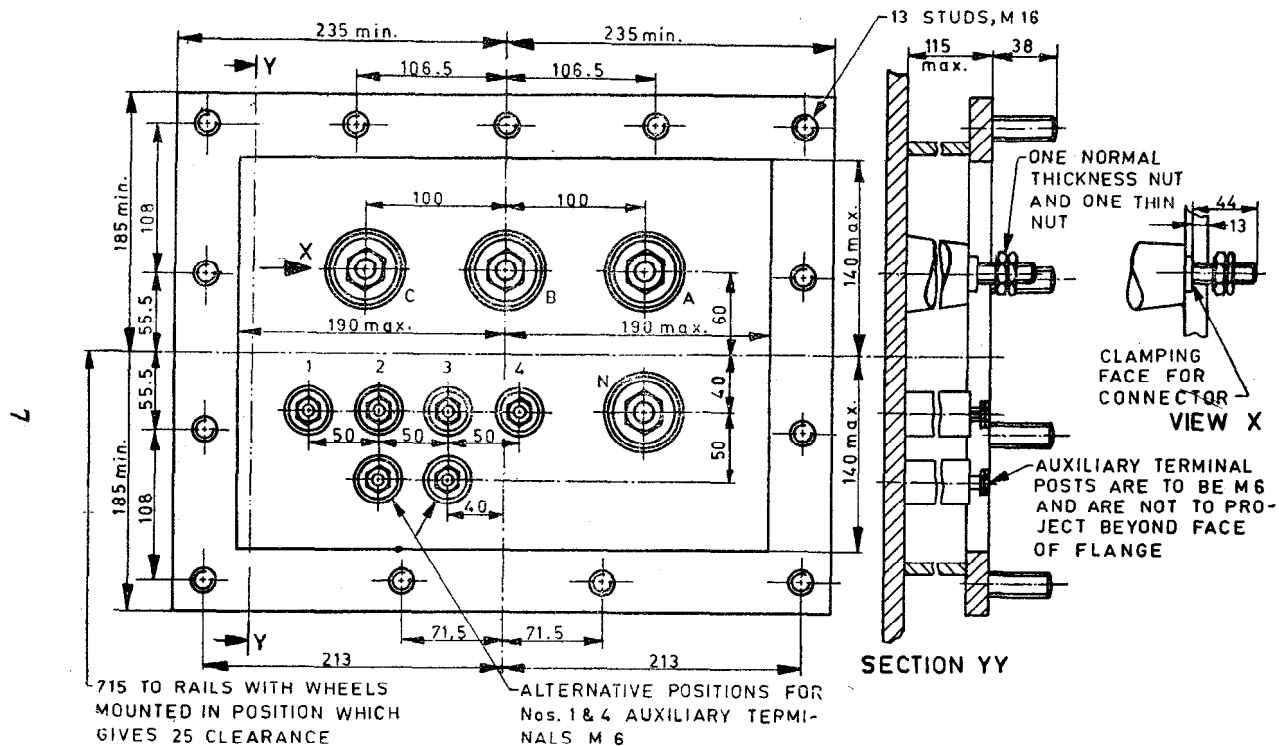
9. MOUNTING FLANGES AND TERMINALS

9.1 Mounting Flanges — Mounting flanges shall be provided on the ends of transformers in accordance with Fig. 1 for lower voltage and Fig. 2 for higher voltage end.

9.2 Terminals — The form and positioning of terminals and their bushings shall be as illustrated in Fig. 1 and Fig. 2.

The dimensions of hexagonal nuts shall comply with the requirements of IS : 1364-1967* for precision grade and the appropriate thread

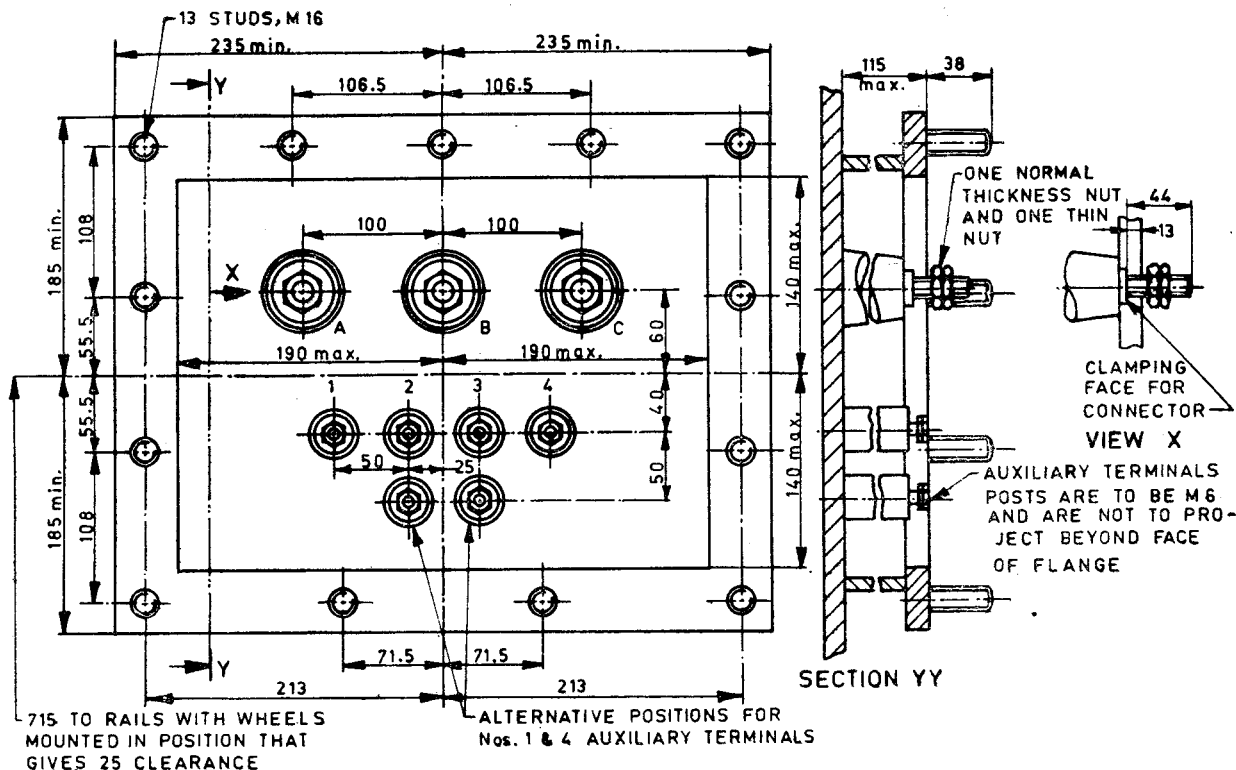
*Precision and semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm) (*first revision*).



All dimensions in millimetres.

FIG. 1 MOUNTING FLANGE AT LOWER VOLTAGE END OF TRANSFORMER

8



All dimensions in millimetres.

FIG. 2 MOUNTING FLANGE AT HIGHER VOLTAGE END OF TRANSFORMER

diameter. For terminals up to and including 12 mm diameter, one normal thickness nut and one thin nut shall be used; for sizes above 12 mm diameter, two thin nuts shall be used. The nuts shall be of brass.

The tolerance class for terminal nuts and stems shall be medium, Class 6H as specified in IS : 4218 (Part 6)-1978*. Threads up to and including M16 are coarse pitch series as specified in IS : 4218 (Part 6)-1978*.

9.3 Clearance and Creepage — The clearance and creepage distances in air shall be not less than the following:

	<i>Up to 1 130 V</i> mm	<i>3 300 and 6 600 V</i> mm
Clearance, phase to phase	25	74
Clearance, phase to earth	25	55
Creepage, phase to earth	32	74

10. PROVISION FOR CABLE TERMINATIONS

10.1 The transformer terminals shall be contained in an air-filled enclosure which may be a separate terminal chamber or may fulfil additional functions, that is, form part of a high voltage circuit breaker or a chamber for housing protective equipment at the lower voltage end of the transformer. Unless otherwise agreed between the purchaser and the manufacturer, the terminal chamber or the equipment of which it forms part (see Fig. 3 and 4) shall be suitable for fitting to the flanges shown in Fig. 1 and 2.

10.2 The terminal chamber or the equipment comprising part of the chamber shall be provided with facing(s) to receive either a cable sealing box(es) or a cable coupler adaptor(s).

When fitted, cable glands and sealing boxes, shall comply with the requirements of IS : 4821-1968† unless otherwise specified by the purchaser and cable coupler adaptors with the requirements of IS : 6789-1972‡.

NOTE — The cable couplers may not, when used singly, have the necessary current rating to carry the output of the larger sizes of transformer. In such cases, more than one outlet will have to be provided with suitable overcurrent protection for each circuit.

10.3 Cable terminations shall be so arranged that cables fitted with cable sealing boxes or other similar fittings can be disconnected and detached from the transformer without disturbing the sealing compound, without

*ISO metric screw threads: Part 6 Limits of sizes for commercial bolts and nuts (diameter range 1 to 52 mm) (first revision).

†Specification for cable glands and cable sealing boxes for use in mines.

‡Specification for bolted flameproof cable couplers and adaptors.

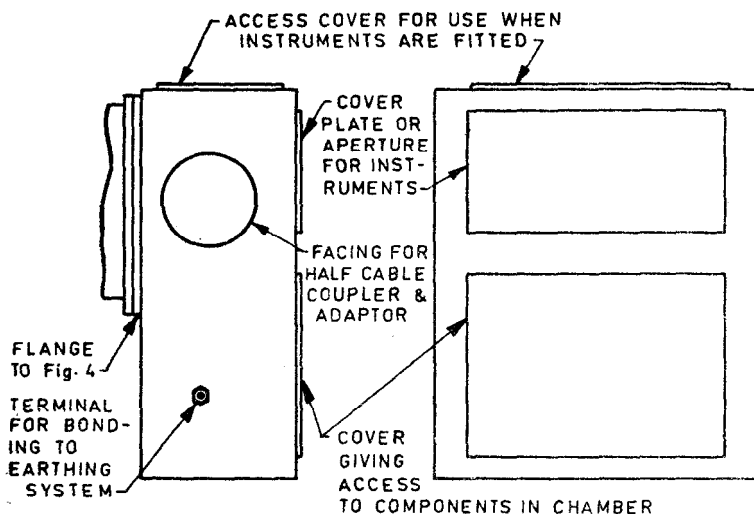


FIG. 3 CHAMBER FOR MOUNTING ON FLANGE AT LOW VOLTAGE END OF TRANSFORMER (DIAGRAMMATIC ONLY)

exposing the interior of the transformer enclosure(s), or without the bushings having to be moved.

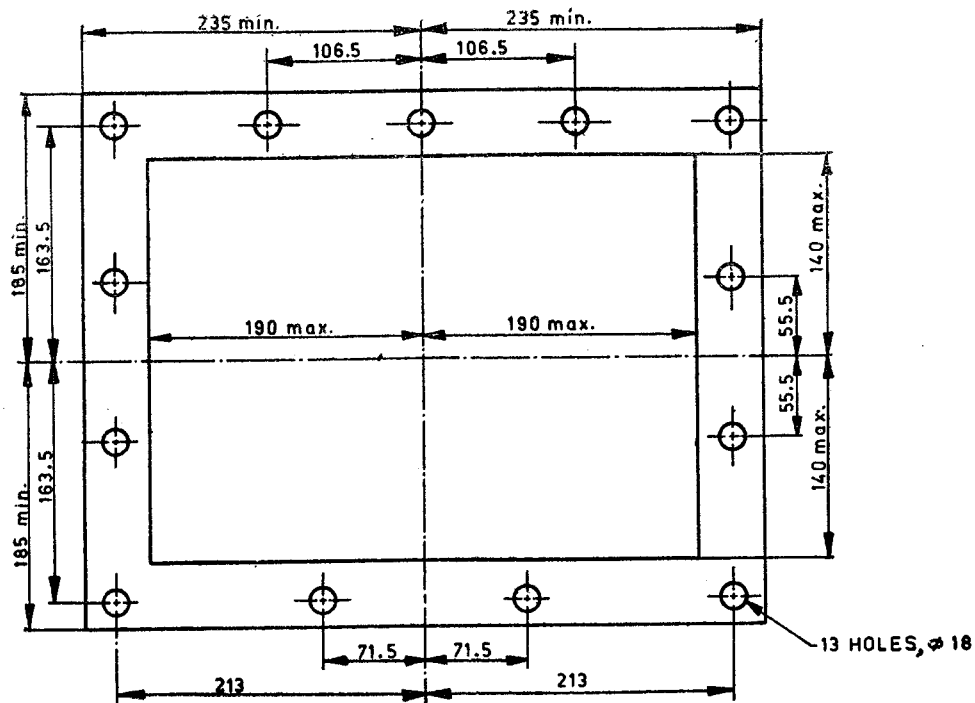
10.4 If required by the purchaser, the manufacturer shall provide covers for protecting the terminals and bushings when a removable type terminal chamber is not in position.

11. OVER-VOLTAGE PROTECTION AND EARTHING

11.1 General — Provision shall be made for protection against danger arising from the charging of the lower-voltage components by contact with, or leakage from, higher-voltage components. To assist in meeting this requirement, provision shall be made for the connection to earth, where necessary, of the neutral point of the secondary winding.

11.2 Provision for Earthing Neutral Point of Secondary Winding — The neutral point of the secondary winding shall be brought out to an insulated terminal.

Two earth terminals shall be provided at the low voltage end of the transformer, either in the low voltage chamber (*see* Appendix A) or in such other fitment as shall be specified, for the termination of neutral to earth connection where necessary. The form of any earth fault protection equipment shall be as specified by the purchaser.



All dimensions in millimetres.

FIG. 4 ANCILLARY EQUIPMENT FLANGE

The connection between the neutral of the transformer and the insulated terminal shall have a current carrying capacity of not less than half that of the connection between the secondary live terminals and the transformer winding.

11.3 Earthing of Enclosure — Two external earthing terminals shall be provided to enable the transformer enclosure to be securely and efficiently earthed irrespective of any means provided for attaching to the cable gland the metallic covering of the cables connected to the transformer.

11.4 Earthing Terminals — Provision shall be made for the mechanical attachment of connections to the earth terminals.

12. OVERALL DIMENSIONS

12.1 For the transformers covered by this specification, the overall dimensions shall not exceed the following values:

<i>Length</i>	<i>Width</i>	<i>Height</i>
mm	mm	mm
3000	1200	400

NOTE 1 — The dimensions relate to the transformer and exclude wheels and axles, cable boxes and other attachments.

NOTE 2 — In case of low-head room, the figures are liable to adjustment.

13. INFORMATION TO BE GIVEN WITH ENQUIRY OR ORDER

13.1 The technical information that the purchaser is required to supply with the enquiry and order is given in Appendix B.

14. MARKING

14.1 The transformer shall be provided with a rating plate securely fitted to it in a visible position, containing the following information:

- a) Name of the equipment, namely, flameproof dry type transformer for use in mines;
- b) Number of this standard, Ref IS : 11333;
- c) Manufacturer's name;
- d) Rated kVA;
- e) Rated voltage;
- f) Rated current;
- g) Rated frequency;

- h) Number of phases;
- j) Connection symbol;
- k) Percent impedance voltage at rated current (corrected to 75°C);
- m) Temperature class of insulation (insulation system temperature) and maximum permissible temperature rise;
- n) Manufacturer's serial number;
- p) Year of manufacturer;
- q) Total mass;
- r) Mass of core and windings; and
- s) Any other marking in accordance with IS : 2148-1981* to indicate flameproof nature of the equipment.

14.2 The transformer shall also be provided with a terminal marking plate giving the information about tapping voltage at each tapping.

14.3 The entries on the rating plate shall be indelibly marked. The inscriptions shall be raised or engraved. The plates shall not be enamelled nor made of aluminium or aluminium alloy.

14.4 The transformer may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

15. TESTS

15.1 Tests for Flameproofness — Tests and checks to prove that the enclosure of transformer is flameproof shall be carried out in accordance with IS : 2148-1981*.

15.2 All other tests shall be carried out according to IS : 11171-1985† and IS : 2026 (Part 1)-1977‡, IS : 2026 (Part 2)-1977§, IS : 2026 (Part 3)-1981|| and IS : 2026 (Part 4)-1977¶, as applicable.

*Specification for flameproof enclosures of electrical apparatus (*second revision*).

†Specification for dry type power transformers

‡Specification for power transformers : Part 1 General (*first revision*).

§Specification for power transformers : Part 2 Temperature-rise (*first revision*).

||Specification for power transformers : Part 3 Insulation levels and dielectric tests (*second revision*).

¶Specification for power transformers : Part 4 Terminal markings, tappings and connections (*first revision*).

APPENDIX A

(Clause 11.2)

EARTH FAULT PROTECTION

A-1 PROTECTION SYSTEMS

A-1.1 Protection systems in use are as follows:

System a — Transformer neutral solidly connected to earth. In this system the flow of current in the neutral-to-earth connection is measured by means of a current transformer. A relay fed by the secondary of the current transformer is set to trip at a predetermined level of current in the neutral; the action of the relay is to trip the high voltage circuit breaker.

An injection coil is provided on the current transformer to permit testing of the protection system.

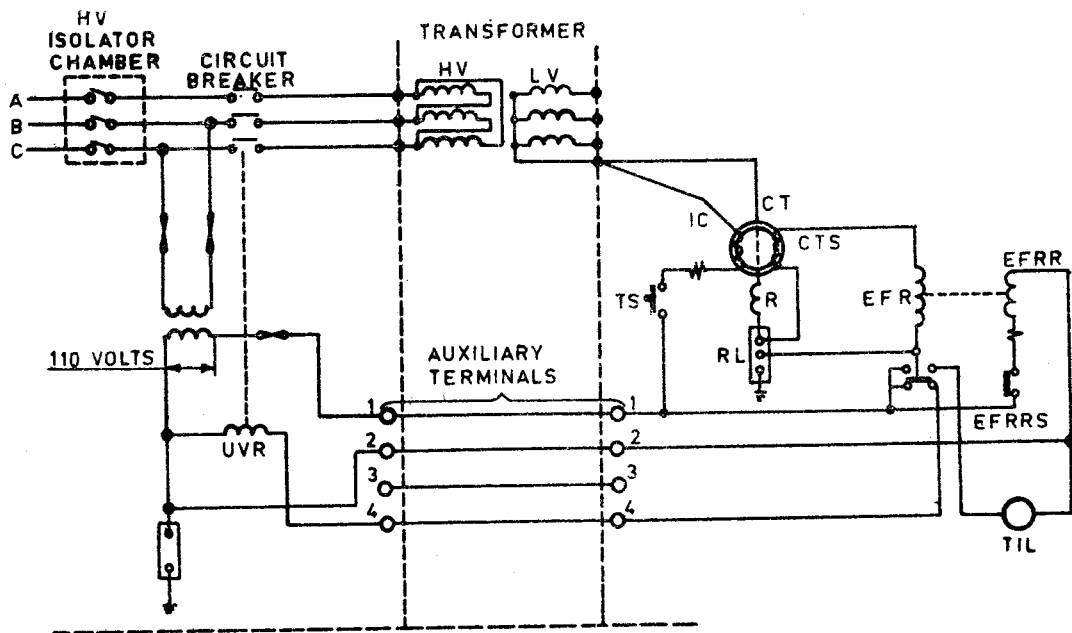
In this system there is no deliberate attempt to restrict the magnitude of fault current in the neutral connection.

System b — Transformer neutral connected to earth through an impedance. This system is similar to system a, with the exception that an impedance, usually, in the form of a reactor, is included in the neutral-to-earth connection. A typical value of current limitation is 15 A. A circuit for this form of protection is shown in Fig. 5.

System c — A system with severe restriction of earth fault current and with sensitive current detection. In this type of system, the neutral current is restricted to a value significantly less than in system b. The value of the neutral current is measured by a detecting circuit which causes a relay to operate at the appropriate level; a circuit is provided to test at, or below, this level.

A-2 HOUSING OF CIRCUIT COMPONENTS

A-2.1 The components of the earth fault protection circuit are housed in a chamber mounted on the flange at the low voltage end of the transformer.



UVR Under voltage release
TS Test switch
CT Current transformer
IC Injection coil
CTS Current transformer secondary
R Reactor

EFR Earth fault relay (latched)
EFRR Earth fault relay reset
EFRRS Earth fault relay reset switch
TIL Trip indicating lamp
RL Removable three point link

FIG. 5 TYPICAL EARTH FAULT PROTECTION CIRCUIT

APPENDIX B

(Clause 13.1)

INFORMATION REQUIRED WITH ENQUIRY AND ORDER

B-1. To enable the supplier make an offer, the purchaser should furnish the following information:

- a) Rated kVA
- b)
 - 1) Primary voltage.
 - 2) Secondary voltage at no-load (*see 3.2*).
 - 3) Connections.
- c)
 - 1) Whether provision is required for wheels and axles (*see 8.7*)
 - 2) Whether wheels are to be provided by the manufacturer or by the purchaser. Details of the wheels and axles should be sent with the order.
 - 3) Range of rail gauge (*see 8.7.1*).
- d)
 - 1) Direction of cable entry/entries at each end, for example whether cable approaches transformer vertically upwards, downwards, or horizontally from left to right, normal to the tank side or end.
 - 2) Whether through-going cable is required.

NOTE — Where switchgear is fitted, cable entry may be limited to one direction only.
- e) Where cable attachments are to be supplied by the manufacturer:
 - 1) The type and relevant Indian Standard number of the attachments and the flange facing required (*see Fig. 3*).
 - 2) The Indian Standard number and the size and type of primary and secondary cable, the number of cables or cable cores per phase, the section of each core, and the diameter under and over the various coverings; also details of the type of coverings, armour, etc.
- f) Whether earth fault protection is required (*see 11*). Where earth fault protection is required, its form should be indicated by the purchaser.

- g) The arrangement required for earthing the secondary winding (*see 11*)
- h) Ancillary equipment to be specified (*see 10*) that is, switchgear, low voltage chamber, instruments, etc.
- j) Ambient conditions, if different from standard service conditions; and
- k) Type of system earthing.

INDIAN STANDARDS

ON

TRANSFORMERS

IS:

- 1180 (Part 1)-1981 Outdoor type three-phase distribution transformers up to and including 100 kVA 11 kV: Part 1 Non-sealed type (*second revision*)
- 1180 (Part 2)-1979 Outdoor type three-phase distribution transformers up to and including 100 kVA 11 kV: Part 2 Sealed type
- 1885 (Part 38)-1977 Electrotechnical vocabulary: Part 38 Transformers (*first revision*)
- 2026 (Part 1)-1977 Power transformers: Part 1 General (*first revision*)
- 2026 (Part 2)-1977 Power transformers: Part 2 Temperature-rise (*first revision*)
- 2026 (Part 3)-1981 Power transformers: Part 3 Insulation levels and dielectric tests (*second revision*)
- 2026 (Part 4)-1977 Power transformers: Part 4 Terminal marking tapplings and connections (*first revision*)
- 2032 (Part 28)-1983 Graphical symbols used in electrotechnology: Part 28 Transformers
- 2772-1982 Non-flameproof mining transformers for use below ground (*first revision*)
- 3151-1982 Earthing transformers (*first revision*)
- 3659-1966 Fittings and accessories for power transformers
- 5553 (Part 1)-1970 Reactor: Parts 1 Shunt reactors
- 5553 (Part 2)-1970 Reactors: Part 2 Series reactors
- 5553 (Part 3)-1970 Reactors: Part 3 Neutral earthing reactors and arc suppression coil
- 6600-1972 Guide for leading of oil immersed transformers
- 8447-1977 Manually operated voltage regulators for domestic use
- 8448-1977 Automatic line voltage correctors (step type for domestic use)
- 8468-1977 On-load tap changers
- 8478-1977 Application guide for on-load tap changers
- 9147-1979 Cable sealing boxes for oil immersed transformers suitable for paper insulated lead sheathed cables for highest system voltages from 12 kV up to and including 36 kV
- 9815-1981 Servo-motor operated line voltage correctors
- 10028 (Part 2)-1981 Code of practice for selection, installation and maintenance of transformers: Part 2 Installation
- 10028 (Part 3)-1981 Code of practice for selection, installation and maintenance of transformers: Part 3 Maintenance
- 10161-1982 Moving coil voltage regulators
- 10561-1983 Application guide for power transformers
- 11171-1985 Dry type power transformers
- 11333-1985 Flameproof dry type transformers for use in mines